

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES

Vol. 47, No. 10, pp. 289-302, 33 figs.

December 10, 1991

A REVISION OF THE WASP GENUS *KOHLIELLA*
(HYMENOPTERA: SPHECIDAE)

By

Wojciech J. Pulawski

Department of Entomology, California Academy of Sciences
Golden Gate Park, San Francisco, California 94118

ABSTRACT: The revision includes a redescription of the genus, a key to the species, a phylogenetic analysis, a summary of the known life history, distribution records, and maps. The two known species of *Kohliella* from southern Africa (*K. alaris* and *K. stevensoni*) are redescribed; the previously unknown female of *K. stevensoni* and a new species (*K. anula*) from Sri Lanka are described. Previously unnoticed characters are used in descriptions and cladistic analysis.

Received December 20, 1990. Accepted March 20, 1991.

INTRODUCTION

GENERAL.—Brauns (1910) established *Kohliella* for his new species *K. alaris* from South Africa. Arnold (1924) described a second species, *K. stevensoni*, from Zimbabwe, and K. V. Krombein recently collected representatives of a third, undescribed species in Sri Lanka. A revision of these species, integrating all available information, is presented here. Finding previously unnoticed characters and reconstructing the phylogeny of the species were among the primary goals.

TECHNICAL TERMS.—Generally the terminology of Bohart and Menke (1976) has been adopted, except I have followed Michener and Fraser (1978) for mandibular terms. The following terms are redefined here for clarification or for convenience:

Disk: central part of a sclerite, e.g., scutal disk.

Mandible:

acetabular groove—see Fig. 2;

adductor ridge—extends distad from the man-

dibular base at its inner (concave) face and gradually becomes visible from the outside; the visible portion is part of the mandibular posterior margin (in *Kohliella*, this portion is markedly, roundly expanded);

condylar ridge—arises from the condyle, extends distad, and constitutes the basal portion of the posterior mandibular margin; it is conspicuously angulate distally in *Kohliella*;

condyle—mandibular articulation on the occipital side of the head capsule;

posterior margin—extends between condyle and mandibular apex; externoventral margin of Bohart and Menke (1976), lower margin of Michener and Fraser (1978); (the term posterior is preferred because the head is hypognathous and this edge is thus oriented posterad);

trimmal carina—cutting edge (or inner margin) of the mandible.

Sternum, tergum: abbreviations for gastral sternum, gastral tergum.

Vertex:

length—the distance between a hindocellar

scar's hindmargin and an imaginary line connecting the eye hindcorners (i.e., the point where the inner and posterior portions of the orbit meet); width—the shortest interocular distance.

SOURCES OF MATERIAL.—Institutions that sent material for study are abbreviated in the text as follows: AMG: Albany Museum, Grahamstown, South Africa (Friedrich W. Gess); BMNH: British Museum (Natural History), London, England (Colin R. Vardy); CAS: California Academy of Sciences, San Francisco, California; SAM: South African Museum, Cape Town, South Africa (Vincent B. Whitehead); SMWN: State Museum, Windhoek, Namibia (John Irish, Eugene Marais); also via Ole Lomholdt, ZMK; TMP: Transvaal Museum, Pretoria, South Africa (Robert B. Toms); USNM: United States National Museum (Smithsonian Institution), Washington, D.C. (Karl V. Krombein, Arnold S. Menke); ZMK: Zoological Museum, Copenhagen, Denmark (Ole Lomholdt).

Genus *Kohliella*

Kohliella Brauns, 1910:668. Type species: *Kohliella alaris* Brauns, 1910:669, by monotypy.

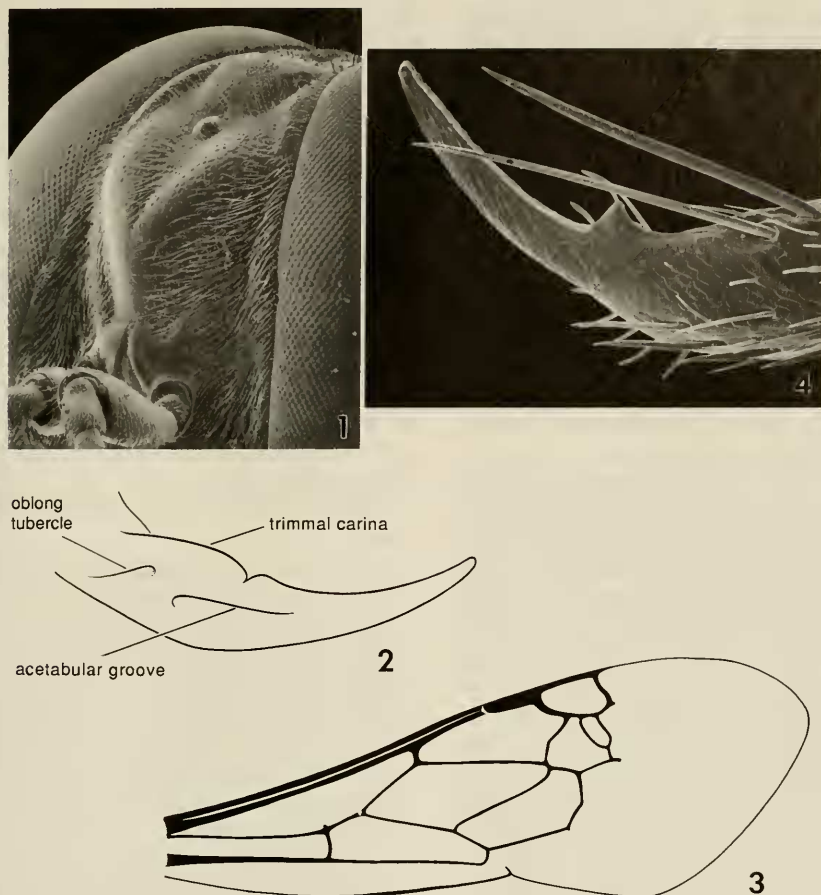
DIAGNOSIS.—Like other members of Larrini, subtribe Tachytina, *Kohliella* has flat, elongate ocelli (Bohart and Menke 1976). Within the tribe, the genus is characterized by the following five autapomorphies: (1) frons with a V-shaped swelling (Fig. 1); (2) mandible with oblong tubercle near proximal end of acetabular groove (Figs. 2, 20); (3) third submarginal cell petiolate posteriorly (Fig. 3); (4) lateral carina of tergum I evanescent behind spiracle and absent posteriorly; and (5) sternum I largely glabrous (setose only basally). In addition, the female claws have a subbasal tooth (Fig. 4), a condition that in Larrinae is shared only with some *Liris*. Bohart and Menke (1976) thought that the strongly compressed mouthparts were also diagnostic, but actually this character has little diagnostic value. First, the prementum is sharply compressed in *K. alaris* and *K. stvensoni* but not in *K. anula* (where it is strongly convex, as it is in some *Prosopigastra*), and, second, the stipites are inclined toward each other at an angle that varies from less than 90° to about 150°. (The inclination, in most other Larrinae, is about 120–150°.)

DESCRIPTION.—*Kohliella* was described in detail by Bohart and Menke (1976), but it is re-described below to take into account the new

species from Sri Lanka, the unknown female of *K. stvensoni*, and some structures not considered previously. The major structural characters of the genus other than the autapomorphies follow:

Posterior mandibular margin notched; notch delimited proximally by angulate apex of condylar ridge, and distally by markedly, roundly expanded distal portion of adductor ridge. Frons with glabrous swelling above each antennal socket (swellings oriented obliquely and nearly joining mesally). Hindocellar scars widely diverging anterolaterad (their long axes forming an angle of about 130°), moderately elongate (scar shorter than distance that separates it from midocellus). Occipital carina joining hypostomal carina. Propodeum short, distance between metanotum and spiracle less than spiracle's length; dorsum setose throughout (*K. anula*) or glabrous mesally. No additional sclerites between metasternal apex and propodeum. Third submarginal cell petiolate posteriorly (Fig. 3). Forecoxal apex not expanded into process. Foretarsomere I with five ventral spines in female and three in male (length of spines about $2.0 \times$ apical width of tarsomere in female and $1.8\text{--}2.1 \times$ in male); female foretarsus with rake that consists of long, flexible setae. Hindtarsomere II long ($0.5\text{--}0.7 \times$ hindtarsomere I). Female claws with subbasal tooth (Fig. 4). Tergum I without short, oblique carina extending from anterolateral corner. Tergum II not carinate laterally. Female tergum VI fairly convex: angle between lateral margin of tergum and lateral margin of pygidial plate, in side view, about 30–40°, pygidial plate with anteriorly evanescent lateral margin, without preapical row of punctures. Sting, including sheaths, slightly flattened, almost circular in cross section. Male sterna without velvety patches; tergum VII not depressed apically; gonostyle ventrally with a few setae.

Additional characters that vary in related genera but which are universal in *Kohliella* include: labrum flat, not emarginate; stipes flat; mouthparts not elongate; clypeus produced into a lobe mesally; anterior portion of lateral clypeal section concave, concavity delimited from above by transverse ridge; inner orbits convergent above; paramandibular process broadly separated from back side of clypeus (mandibular socket open); hindtibia not ridged; marginal cell short (foremargin $1.2\text{--}1.8 \times$ maximum width); foretibia spinose on outer side; inner hindtibial spur with stout, spaced rays in distal half; female:



FIGURES 1-4. Generic characters of *Kohliella* exemplified by *K. alaris*: 1—female face, 2—female mandible, 3—forewing, 4—claw of female hindtarsus.

trimmal carina with cleft and subbasal tooth that is modified into long, rounded lobe (Fig. 2), dorsal length of flagellomere I $2.9\text{--}3.3\times$ apical width, spines of foretarsal rake compressed laterally near base and compressed dorsoventrally near apex (three to five basal spines of foretarsomere I not compressed apically), forebasitarsus I with eight or nine rake spines, foretarsomere II and III with two rake spines each, forefemoral venter shiny, with few, sparse punctures, venter of tarsomere V with straight apical margin (i.e., margin not expanded into a lobe); male: tergum VII without lateral pygidial carinae, sternum VIII not emarginate apically, foretarsus with well-developed rake.

LIFE HISTORY.—Life history is known for only one species, *K. alaris* (Gess and Gess, 1980).

Wasps become active after noon, "when the heat of the day is past its peak," sometimes as late as 16:15 hr. Nests are dug in flat, sandy areas with sparse vegetation. Nest construction precedes hunting. The female uses her forelegs for digging but carries away larger particles in her mandibles. The burrow enters the soil at a flat angle and has one or several secondary branches, some of which end in a cell. The entrance is temporarily closed during the provisioning period when the wasp is away. Nymphal tree crickets *Oecanthus filiger* Walker, 1871 ($=O. capensis$ de Saussure, 1878), 6.0–15.8 mm long, are used as prey; all have their antennae partly amputated (amputation presumably takes place shortly after capture). They are carried in flight beneath the wasp's body, head forward. The female lands

close to the nest entrance, drops the prey, opens the nest by raking the sand away, enters, turns around within, and draws the prey in headfirst. Several prey are stored in a cell, venter up and head inward. The wasp's egg, attached to the prey by its cephalic end, is placed behind the right or left prothoracic coxa and oriented transversely across the venter. In the six cases observed, the egg was deposited on prey that was brought in first, second, or fourth, suggesting that oviposition may be postponed until a prey of suitable size is obtained.

GEOGRAPHIC DISTRIBUTION.—*Kohliella* occurs in two widely separated areas: Sri Lanka and southern Africa (from Zimbabwe and Namibia to the Cape of Good Hope area).

RELATIONSHIPS TO OTHER LARRINI.—Bohart and Menke (1976) produced a dendrogram of the larrin genera, which was presumably based on the 50 characters listed on page 224 (the dendrogram was intuitive, since branches were not supported by character distribution and plesiomorphies may have been used as well). Bohart and Menke's dendrogram indicated that *Kohliella* was most closely related to *Holotachysphex*, *Parapiagetia*, *Prosopigastra*, and *Tachysphex*. Pulawski (1979) recognized additional apomorphies and analyzed phylogenetic relationships of the latter four genera. My current analysis indicates that *Kohliella* is a member of a holophyletic lineage that includes *Holotachysphex*, *Parapiagetia*, and *Tachysphex*. This clade is characterized by an oblong, glabrous swelling above each antennal socket. Another synapomorphy, the loss of a basal oblique carina on tergum I, is also found in *Gastrosericus*, many *Tachytes*, and *Larropsis chilopsidis* Cockerell and W. Fox, 1897. This carina is present in the other Larrinae, including *Prosopigastra*, and in most other Sphecidae, although species with petiolate gaster such as Sphecinae and most Pemphredoninae are obvious exceptions.

CHARACTER ANALYSIS.—The three closest relatives of *Kohliella* (i.e., *Holotachysphex*, *Parapiagetia*, and *Tachysphex*) were used as the outgroup in establishing character transformations and polarities, although other Larrini were considered. I regard as plesiomorphic those states that are shared by *Kohliella* and the outgroup, and as apomorphic those states that are found only in some *Kohliella* but not in the outgroup. Character states that occur in some *Kohliella* and

some members of the outgroup were not polarized unless additional evidence indicated that they have developed independently. Fourteen characters were considered, but unequivocal polarities were established only for the first seven. Several unpolarized characters were subsequently polarized during the analysis (see PHYLOGENETIC ANALYSIS). The polarized characters are (0: plesiomorphic, 1 and 2: apomorphic):

(1) Prementum: 0. evenly convex, 1. knife-like.

The generalized prementum of the Sphecidae is evenly convex, but it is knife-like, compressed (at least apically) in two species of *Kohliella* (*K. alaris* and *K. stvensoni*) and in *Aha*, a member of the Miscophini. The knife-like prementum is clearly an apomorphy, independently acquired in the two genera.

(2) Shape of thorax: 0. not flattened, 1. flattened.

The thorax of most Larrinae is essentially circular in cross section, but strongly flattened dorsoventrally in *K. stvensoni*, in some Australian *Tachysphex* (*T. depressiventris* R. Turner, 1916, *T. foliaceus* Pulawski, 1977, and *T. persistans* R. Turner, 1916), and to a lesser degree in some *Liris* (e.g., an unidentified species from Sri Lanka). A flat thorax is clearly derived and also independently acquired in all three genera: *Liris* is only distantly related to *Kohliella* as evidenced by many characters (Bohart and Menke 1976, placed these genera in different subtribes), and *Tachysphex* with a depressed thorax are all members of a specialized lineage (Pulawski 1977, 1988). The flattened thorax is correlated with the depressed forecoxa in *K. stvensoni* and the *Tachysphex* listed above.

(3) Propodeal dorsum: 0. ridged, 1. sparsely punctate.

The propodeal dorsum is rugose in *Holotachysphex*, rugose or variously ridged in *Tachysphex*, and mostly ridged in *Parapiagetia*. It is, however, partly punctate with ridges evanescent in some *Parapiagetia* such as *P. subpetiolata* (Brèthes, 1909), and the sculpture varies individually in others, e.g., *P. genicularis* (F. Morawitz, 1890). In the latter, the dorsal ridges are either well defined or evanescent; when so, the integument is shiny, punctate. In *Kohliella*, the dorsum is either ridged (*K. anula*, *K. alaris*) or punctate (*K. stvensoni*). I regard the latter condition as a specialization independently acquired by *Parapiagetia* and *Kohliella*.

(4) Propodeal vestiture: 0. dorsum setose throughout, 1. narrowly asetose medially, 2. broadly asetose.

The propodeal dorsum is setose throughout in *Holotachysphex*, most *Parapiagetia*, and most *Tachysphex*, but glabrous posteriorly in some *Parapiagetia*, glabrous in *Tachysphex sinaiticus* Pulawski, 1964, and many *T. tenuis* R. Turner, 1908, and largely glabrous in many *T. walkeri* R. Turner, 1908 (the latter three species are members of specialized lineages, and in neither is the glabrous area sharply delimited). The dorsum is setose in most other Larrini, but with a glabrous, well defined area mesally in *Ancistromma*, *Larropsis*, *Prosopigastra*, and also in *Tachytes dichrous* F. Smith, 1856, and *T. pygmaeus* Kohl, 1888. In *Kohliella*, the dorsum is setose throughout in *K. stvensoni*, narrowly glabrous mesally in *K. anula*, and broadly glabrous in *K. alaris*.

(5) Sternal setae of male: 0. sterna setose throughout, 1. sterna asetose.

Male sterna are setose throughout in most Larrinae, including *Holotachysphex* and *Parapiagetia*, although the setae may be variously modified. The sterna are asetose in *Kohliella anula*, and sterna III–VI are largely asetose in several *Tachysphex*. The absence of setae is a convergence, because in *Tachysphex* this condition occurs only in derived species groups, e.g., *T. juliani* and *T. albocinctus* groups, and in *Tachysphex menkei* Pulawski, 1982 of the *T. brullii* group (Pulawski 1971, 1988).

(6) Gastral apex and genitalia of male: 0. generalized, as in *K. alaris* and *K. stvensoni*, 1. complex, as in *K. anula* (see these species for details).

The gastral apex and genitalia in the male of *K. anula* are unique in Larrinae and clearly autapomorphic.

(7) Tibial dorsum: 0. setose throughout, 1. glabrous.

The tibiae are evenly setose throughout in most Larrinae (including *Kohliella anula*), but the tibial dorsum is glabrous in some species that live in open areas with high sun activity such as deserts (e.g., *Holotachysphex turneri* Arnold, 1923, *K. alaris*, and *K. stvensoni*). Apparently, the glabrous tibial dorsum is a specialization independently acquired in these two genera. Possibly, the glabrous integument may reflect solar rays.

I was unable to polarize the following characters:

(8) Clypeal lobe of male: a. angulate laterally, b. rounded.

The clypeal lobe in male Larrini is either angulate laterally (the lobe is thus clearly delimited) or evenly arcuate (the free margin of the lobe forms a single curved line with the rest of the clypeal margin). Both types are found in most genera, although the lobe is only angulate in *Ancistromma* and only arcuate in *Larropsis*. The absence of the lobe corners is usually (as in *K. stvensoni*) correlated with absence of the tooth on the inner mandibular margin.

(9) Episternal sulcus: a. complete, b. incomplete.

The episternal sulcus in Larrini extends to the anteroventral margin of the mesopleuron (sulcus complete) or ends before reaching the margin (sulcus incomplete). Bohart and Menke (1976: 224) listed the complete sulcus among the ancestral characters of Larrinae, but an incomplete one (ending near margin) is predominant in my outgroup. The sulcus is incomplete in *Holotachysphex*, most *Parapiagetia* including *P. genicularis* (F. Morawitz, 1890), one of the most primitive members of the genus, the vast majority of *Tachysphex*, and also in *K. anula*. It is complete in some *Parapiagetia* (e.g., *P. tridentata* Tsuneki, 1972), some *Tachysphex* (such as *T. nigricolor* Dalla Torre, 1897), and in *K. alaris* and *K. stvensoni*.

(10) Punctuation of mesothoracic venter: a. dense, b. sparse.

Punctures are almost contiguous on the mesothoracic venter in *Holotachysphex*, most *Parapiagetia*, and most *Tachysphex*, but several to many diameters apart in some *Parapiagetia* (e.g., *P. genicularis* and *P. tridentata*) and several unrelated *Tachysphex* such as *T. iridipennis* (F. Smith, 1873) and *T. nitidissimus* de Beaumont, 1952. Punctures are almost contiguous in *K. anula*, but sparse, many diameters apart in *K. alaris* and *K. stvensoni* (interspaces shiny).

(11) Male forefemur: a. entire, b. emarginate basally.

The male forefemur is entire in most Larrinae (including *Parapiagetia*) and is emarginate basally in *Holotachysphex*, most *Tachysphex*, and some *Tachytes*; the basal emargination of *Ancistromma* and *Larropsis*, situated in a different plane, may not be homologous. The emarginate femur of the above genera is clearly specialized (Bohart and Menke 1976), but reversals appar-

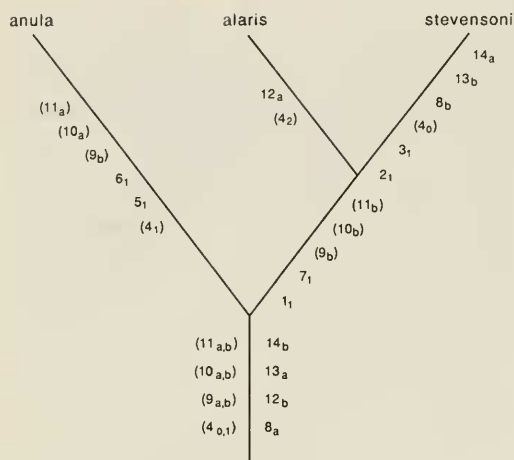


FIGURE 5. Phylogenetic relationship among species of *Kohliella*. Numbers refer to the characters discussed in the text. Numerical subscripts indicate the originally polarized characters and alphabetical subscripts the originally unpolarized characters. Numbers in parentheses represent characters that remain unpolarized (they were superimposed on the cladogram branches to show their distribution).

ently have occurred. For example, the *T. geniculatus* group of *Tachysphex* has an entire forefemur, but the elongate mouthparts and an unusually broad vertex suggest that these species descended from less specialized forms in which the femora were emarginate (Pulawski 1971). In *Kohliella*, the forefemur is entire in *K. anula*, and emarginate basally in the other two species. It is not clear if the condition of *K. anula* is plesiomorphic or a reversal.

(12) Shape of setae: a. straight, b. sinuate.

The setae of Sphecidae (including the outgroup) are either straight or sinuate. In *Kohliella*, the setae are straight in *K. alaris* (some setae bent apically), straight on vertex but sinuate on other body parts in *K. anula*, and all sinuate in *K. stensonsi*. I recognize only two states: thoracic setae straight, and thoracic setae sinuous.

(13) Vertex setae: a. short, b. long.

Vertex setae vary in length in the outgroup and other Larrinae. They are short in *K. alaris* and *K. anula*, but long in *K. stensonsi*. Species with long setae occur in three habitat types: in deserts, mountains, and humid tropical or subtropical areas.

(14) Forefemoral setae: a. venter setose, b. glabrous.

The forefemoral venter is evenly setose in most Larrinae (including *K. stensonsi*), but glabrous or nearly so in many lineages (glabrous in *K. alaris* and *K. anula*).

PHYLOGENETIC ANALYSIS.—Of the 14 characters analyzed, only the first seven are polarized and only two (1 and 7) are synapomorphies, significant in reconstructing relationships. The remaining characters are either autapomorphies (2, 3, 5, 6) or multistate (4). The most parsimonious cladogram for the three species (Fig. 5) was generated manually, using the two polarized characters only. The nonpolarized character states were subsequently mapped on the tree in the most parsimonious way. The cladogram was verified using Henning86 version 1.5, a parsimony computer package by James F. Farris. The number of steps is 16 and the consistency index (excluding the autapomorphies, i.e., characters 2, 3, 4, and 5) is 100. The cladogram suggests that:

(1) The two African *Kohliella* are sister species, thus more closely related to each other than to *K. anula*.

(2) Contrary to my initial interpretation, the states of character 4 (entirely setose and glabrous propodeal dorsum) cannot be polarized (i.e., it is equally parsimonious to regard each of them as either ancestral or derived).

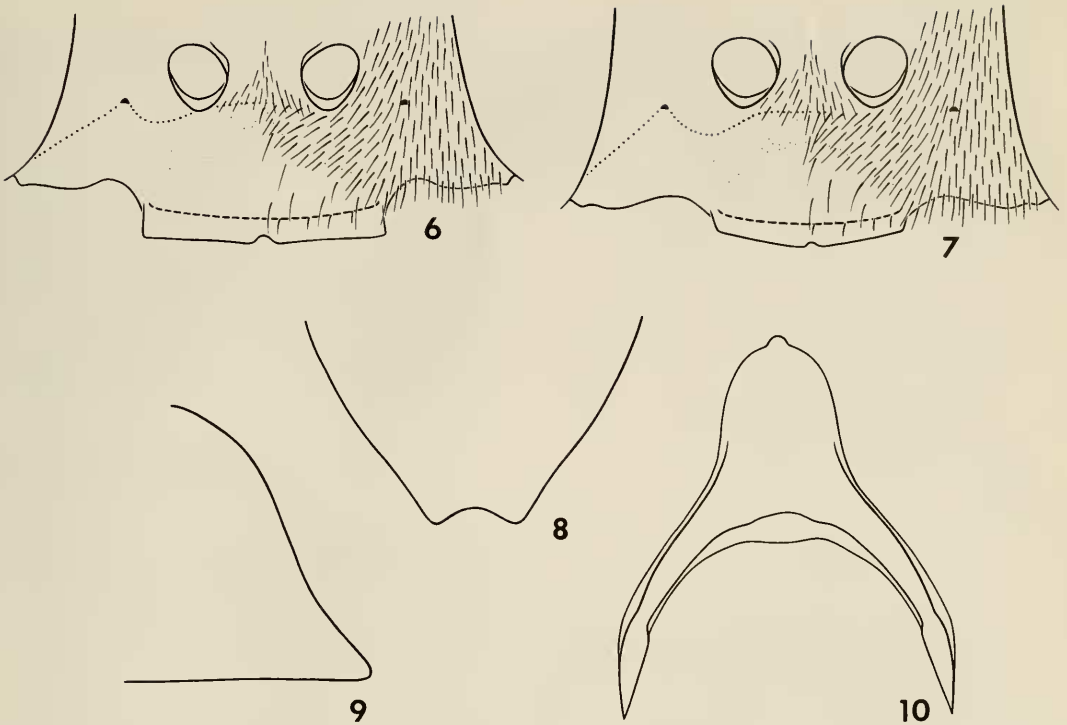
(3) The following initially unpolarized character states of *Kohliella* are derived: clypeal lobe of male not angulate laterally (8b), thoracic setae straight (12a), vertex setae long (13b), and forefemoral venter setose (14a).

(4) Three characters cannot be polarized: length of episternal sulcus (9), punctuation of mesothoracic venter (10), and presence or absence of forefemoral notch (11). It is equally parsimonious to regard each of the two states as either plesiomorphic or apomorphic.

A better knowledge of the cladistic relationships in the outgroup may either corroborate or invalidate the above conclusions.

KEY TO THE SPECIES

1. Vertex setae sinuous, about $0.8 \times$ basal mandibular width; propodeum: dorsum setose throughout, dorsum and side sparsely punctate; forecoxal venter flat; tibiae red; female: thorax strongly flattened; male: clypeal lobe rounded, not angulate laterally (Fig. 30), inner mandibular margin not



FIGURES 6-10. *Kohliella anula*: 6—female clypeus, 7—male clypeus, 8—male tergum VII dorsally, 9—male tergum VII laterally, 10—male sternum VIII.

- dentate (Fig. 31); Zimbabwe, Namibia 3. *K. stvensoni* Arnold
- Vertex setae straight, about $0.3\times$ basal mandibular width; propodeum (Fig. 17): dorsum glabrous mesally, dorsum transversely ridged, side ridged or with almost uniform, dull microsculpture; forecoxal venter convex; tibiae black; female thorax of usual shape; male: clypeal lobe angulate laterally (Figs. 7, 19), inner mandibular margin with tooth 2
2. Gaster black; distance between corners of clypeal lobe 1.6 (female) and $1.4-1.5$ (male) \times clypeal length (Figs. 18, 19); punctures many diameters apart on scutal disk and mesothoracic venter; male: tergum VII convex, straight apically, sterna III–VI densely punctate apically, sternum VIII rounded apically (Fig. 23), forefemur emarginate basoventrally (Figs. 21, 22); South Africa, Zimbabwe. 2. *K. alaris* Brauns
- Gaster red; distance between corners of clypeal lobe 2.8 (female) and 2.3 (male) \times

clypeal length (Figs. 6, 7); punctures less than one diameter apart on scutum and mesothoracic venter; male: tergum VII saddle-shaped (Fig. 9), emarginate apically (Fig. 8), sterna sparsely punctate, sternum VIII pointed apically (Fig. 10), forefemur entire; Sri Lanka 1. *K. anula* sp. n.

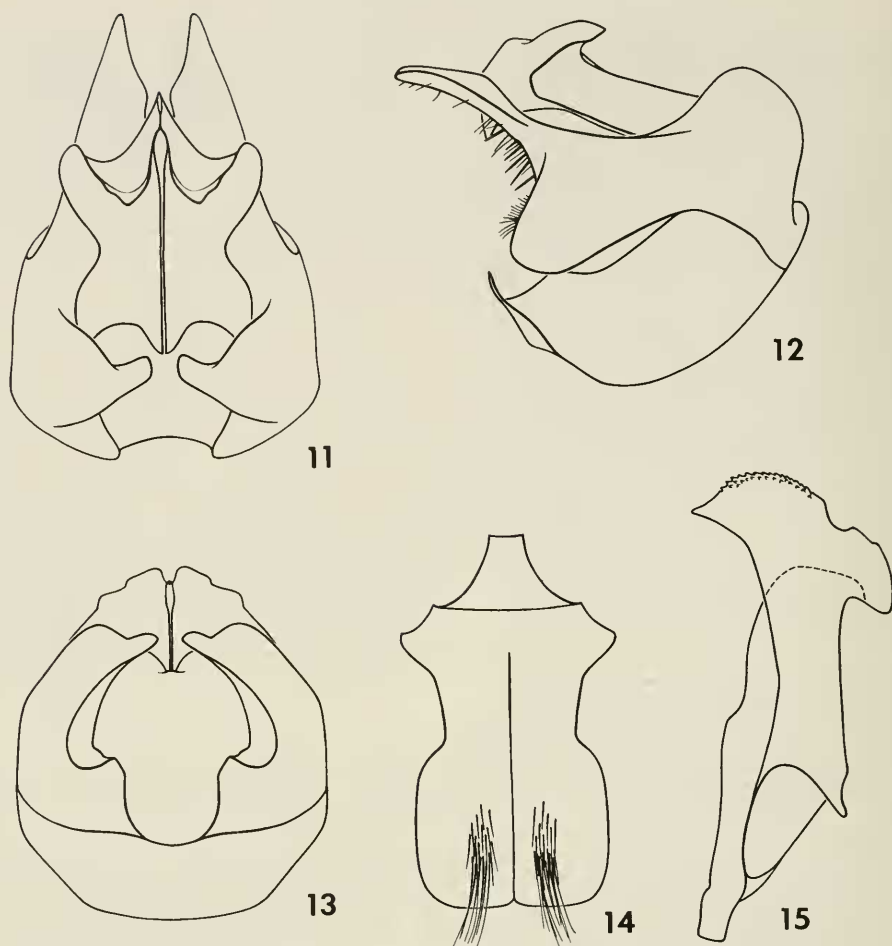
DESCRIPTIONS OF SPECIES

Diagnostic characters for each species are given in the key and are not repeated in the descriptions.

Kohliella anula sp. n.
(Figures 6–15)

DERIVATION OF NAME.—Queen Anula, King Devanampiya Tissa’s sister-in-law, was the first in Sri Lanka to be ordained a Buddhist nun; noun in apposition.

DESCRIPTION.—Clypeal lobe angulate laterally (Figs. 6, 7). Mouthparts moderately compressed laterally, prementum convex but not blade-like.



FIGURES 11–15. *Kohliella anula*: 11—male genitalia dorsally, 12—male genitalia laterally, 13—male genitalia dorsobasally, 14—volsella, 15—penis valve.

Vertex width $0.9 \times$ length. Punctures less than one diameter apart on scutum and mesothoracic venter. Episternal sulcus ending well before reaching anteroventral mesopleural margin. Propodeum: dorsum transversely ridged, with glabrous area that is not broadened anterad, side with well defined ridges. Forecoxal venter convex. Forefemoral venter glabrous. Tibiae densely setose throughout. Setae straight on vertex, sinuous adjacent to hypostomal carina, mesopleuron, and propodeum. Setal length (expressed as fraction of basal width of mandible): 0.3 on vertex, about 0.6 between mandibular condyle and occipital carina, about 1.0 between propodeal side and hindface.

Gaster red, legs black.

♀.—Distance between corners of clypeal lobe

$2.8 \times$ clypeal length. Most spines of foretarsal rake spatulate. Length 10.0 mm.

♂.—Distance between corners of clypeal lobe $2.3 \times$ clypeal length. Inner mandibular margin with tooth. Dorsal length of flagellomere I $2.2 \times$ apical width. Foretrochanteral and forefemoral venters flattened but not notched. Tergum VII saddle-like, apical margin emarginate (Figs. 8, 9). Sterna sparsely punctate, glabrous (with only a few, sparse setae). Sternum VIII bent down apically, hindmargin pointed (Fig. 10). Length 6.0–7.3 mm. Genitalia (Figs. 11–15): Volsellae fused into flat, oblong, weakly sclerotized plate (Fig. 14); plate small, about 0.6 length of penis valve.

COLLECTING PERIOD.—15–16 February 1979.

HABITAT.—The specimens were collected in Dry Zone thorn scrub jungle on damanas, open

areas of sandy loam soil with sparse tufts of grass and a few small shrubs. The elevation is about 30 m and the average annual rainfall about 1,200 mm.

GEOGRAPHIC DISTRIBUTION.—Sri Lanka (Fig. 16).

RECORDS.—Holotype: ♀, Sri Lanka: Mannar District: 0.8 km NE Kokmotte in Wilpattu National Park, about 8°32'N, 80°02'E, on the north side of the Moderagam Aru (=River), one of the boundaries with Puttalam District, K.V. Krombein, T. Wijesinhe, S. Siriwardane, T. Guna-wardane (USNM).

Paratypes: same data (2 ♂, CAS, USNM).

Kohliella alaris Brauns

(Figures 17–27)

Kohliella alaris Brauns, 1910:669, ♂. Holotype: South Africa: Cape Province: Willowmore (TMP), examined.—Arnold, 1922:135 (revision), 1924:43 (♀; South Africa and Zimbabwe); de Beaumont, 1967:510 (South Africa: Table Mountain); Bohart and Menke, 1976:286 (listed); Gess and Gess 1980:45 (life history); Gess, 1981:20 (South Africa; nesting in friable soils), 40 (digging nest), 47 (prey).

DESCRIPTION.—Clypeal lobe angulate laterally (Figs. 18, 19). Mouthparts strongly compressed laterally, prementum blade-like apically. Vertex width $0.9 \times$ length. Punctures many diameters apart on mesothoracic venter and also on female scutal disk, one to two diameters apart on male scutum. Episternal sulcus extending to antero-ventral mesopleural margin. Propodeum: dorsum transversely ridged, with glabrous area that is broadened anterad (ridges in glabrous area extremely fine); side dull, densely ridged (ridges dense, ill defined or reduced in many specimens). Forecoxal venter convex. Forefemoral venter glabrous. Midtibia glabrous dorsally (also female hindtibia). Setae straight on vertex, curved apically on gena and propodeum. Setal length (expressed as fraction of basal width of mandible): 0.3 on vertex, 0.4 between mandibular condyle and occipital carina, 0.6 between propodeal side and hindface.

Gaster and legs black, apical tarsomeres ferrugineous.

♀.—Distance between corners of clypeal lobe $1.6 \times$ clypeal length. Foretarsal rake consisting of simple spines. Length 7.6–9.8 mm.

♂.—Distance between corners of clypeal lobe 1.4 – $1.5 \times$ clypeal length. Inner mandibular margin with tooth (Fig. 21). Dorsal length of flagellomere I $2.1 \times$ apical width. Foretrochanteral



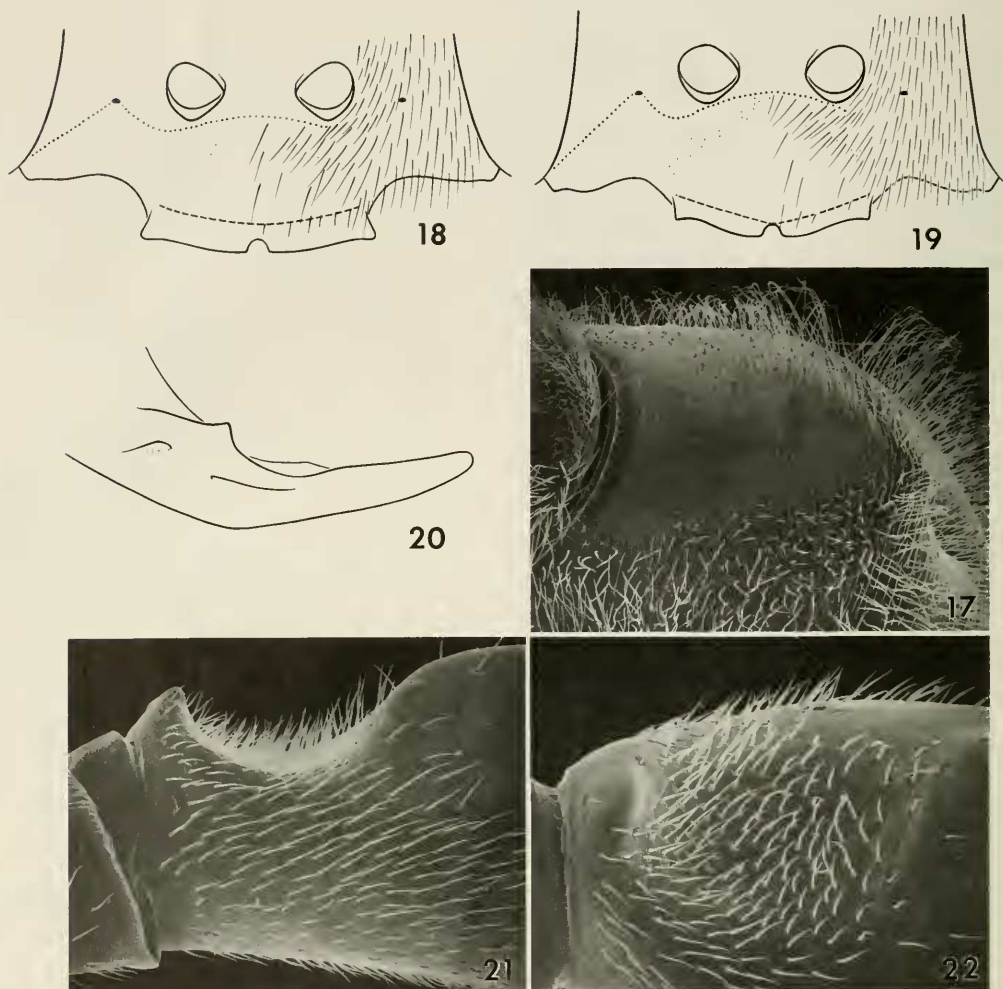
FIGURE 16. Map of Sri Lanka indicating type locality of *Kohliella anula*.

venter notched basally. Forefemur notched basoventrally, notch lined with setae. Tergum VII convex dorsally, apical margin straight. Sterna III–VI apically setose and densely punctate. Sternum VIII straight, its apical margin rounded (Fig. 23). Genitalia (Figs. 24–27): Length 6.5–8.4 mm.

COLLECTING PERIOD.—November (Brauns 1910), early December to early March (Gess and Gess 1980), early February to mid-April (specimens from Zimbabwe).

GEOGRAPHIC DISTRIBUTION.—South Africa, Zimbabwe (Fig. 28).

RECORDS.—SOUTH AFRICA. **Cape Province:** Alicedale (Gess and Gess 1980), Augrabies Falls National Park (F. W. Gess, pers. comm.), Ceres (7 ♀, 13 ♂, BMNH; 1 ♀, 1 ♂, USNM), Hex River (1 ♀, SAM), Hilton 18 km WNW Grahamstown (3 ♀, 3 ♂, CAS), Hout Bay on Cape Peninsula (de Beaumont 1967), Huguenot, 33°43'S, 18°58'E (1 ♂, BMNH), Jonkershoek,



FIGURES 17-22. *Kohliella alaris*: 17—propodeal dorsum, 18—female clypeus, 19—male clypeus, 20—male mandible, 21—male forefemoral notch in profile, 22—bottom of male forefemoral notch.

33°58'S, 18°58'E (1 ♀, BMNH), Mitchell Pass, 32°33'S, 26°53'E (1 ♂, BMNH), Silvermine Nature Reserve on Cape Peninsula (8 ♀, 2 ♂, BMNH), Table Mountain in Cape Town (1 ♀, SAM), Tierberg, 33°07'42"S, 22°16'24"E (F. W. Gess, pers. comm.), Wellington (2 ♀, 4 ♂, CAS), Willowmore (1 ♂, TMP, holotype of *K. alaris*). **Transvaal:** Modderfontein (1 ♂, SAM), 5 mi N Warmbad (1 ♀, 3 ♂, USNM). **ZIMBABWE:** Bulawayo (2 ♀, 1 ♂, SAM), Nyamandhlovu (1 ♀, 1 ♂, SAM).

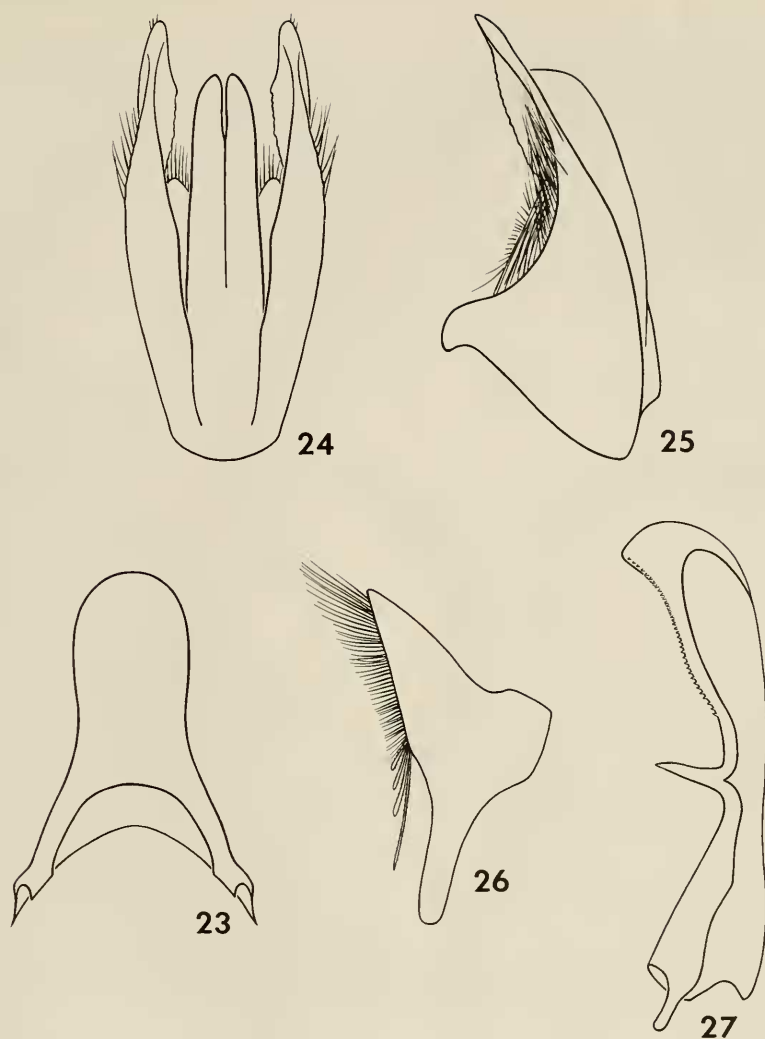
Kohliella stevensoni Arnold

(Figures 29-33)

Kohliella Stevensoni Arnold, 1924:42, ♂, incorrect original cap-

italization. Lectotype: ♂, Zimbabwe: Sawmills (SAM), present designation, examined.—Bohart and Menke, 1976:286 (listed).

DESCRIPTION.—Clypeal lobe and thoracic punctation sexually dimorphic. Mouthparts strongly compressed laterally, prementum blade-like apically. Vertex width 1.0–1.2× length. Episternal sulcus extending to anteroventral mesopleural margin. Propodeum: dorsum sparsely punctate, setose throughout, side unsculptured except sparsely punctate posteriorly. Forecoxal venter flat. Forefemoral venter setose. Mid- and hindtibiae glabrous dorsally. Setae sinuous on vertex, gena, and thorax; setal length (expressed as fraction of basal width of mandible): about



FIGURES 23–27. *Kohliella alaris*: 23—male sternum VIII, 24—male genitalia dorsally, 25—male genitalia laterally, 26—volsella, inner side, 27—penis valve.

0.8 \times on vertex and tergum I basally, about 1.0 adjacent to hypostomal carina and between propodeal side and hindface.

Gastral segments I–III red, remainder black. Femora red in female; male fore- and midfemora all black or black basally and red apically, hindfemur all red or black basally. Tibiae and tarsi red.

♀.—Clypeal lobe angulate laterally (Fig. 29), distance between corners 1.5 \times clypeal length. Thorax strongly flattened. Punctures two to four diameters apart on scutum, many diameters apart on mesothoracic venter. Spines of foretarsal rake spatulate. Length 13.0 mm.

♂.—Clypeal lobe not angulate laterally, its free

margin forming single curved line with rest of clypeal margin (Fig. 30). Inner mandibular margin not dentate (Fig. 31). Dorsal length of flagellomere I 2.6–2.8 \times apical width. Punctures one to two diameters apart on scutal disk, up to two or three diameters apart on mesothoracic venter. Foretrochanteral venter shallowly notched basally. Forefemur notched basoventrally, notch covered with dense, erect setae. Tergum VII convex dorsally, apical margin straight. Sterna III–VI apically setose and densely punctate. Sternum VIII straight, its apical margin rounded. Genitalia: general shape as in *K. alaris* (see Figs. 24, 25); volsella (Fig. 26); penis valve (Fig. 27). Length 8.4–10.0 mm.

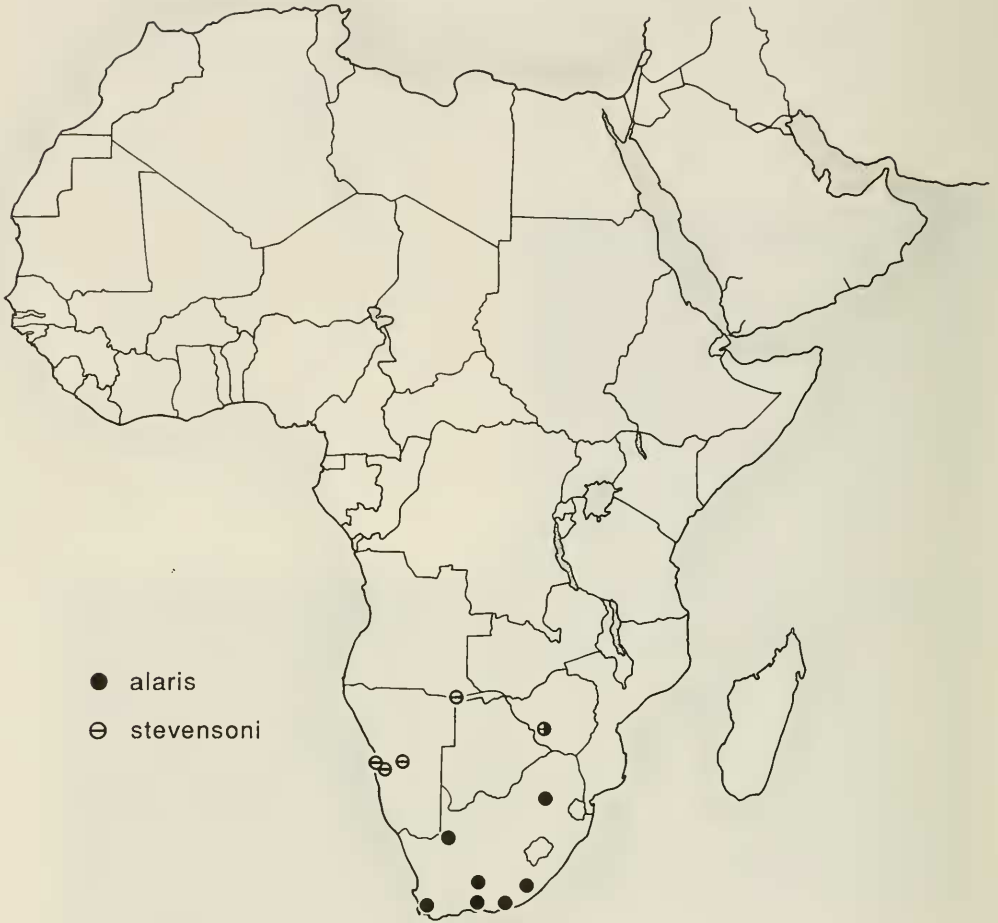


FIGURE 28. Geographic distribution of *Kohliella alaris* and *K. stensonsi* (the combined symbol indicates that both species occur in one locality).

COLLECTING PERIOD.—February, August, October (specimens from Namibia), July (specimens from Zimbabwe).

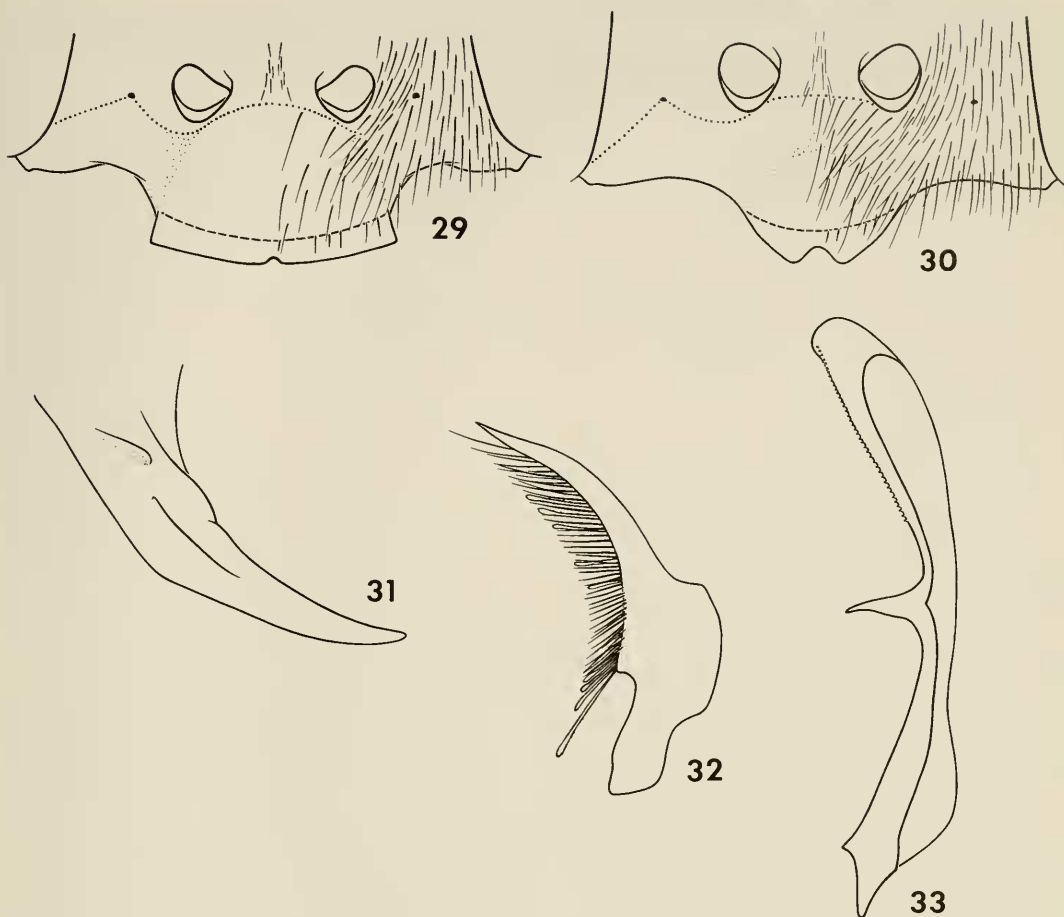
GEOGRAPHIC DISTRIBUTION.—Zimbabwe, Namibia (Fig. 28).

RECORDS.—**NAMIBIA:** **Kaokoland:** Ondorusu Falls, SE 1713 Bd [=between 17°15' and 17°30'S and 13°45' and 14°00'E] (1 ♀, SMWN). **Kavango District:** Andara (1 ♀, 1 ♂, SMWN; 1 ♀, ZMK), Popa Falls, 18°07'S, 21°33'E (1 ♀, CAS; 1 ♀, 1 ♂, SMWN). **Maltahöhe District:** Blässkranz, 24°06'S, 16°14.5'E (1 ♀, SMWN). **Swakopmund District:** Gobabeb, Kuiseb River bed

(1 ♂, ZMK). **Windhoek District:** Windhoek (2 ♀, SMWN). **ZIMBABWE:** Sawmills (2 ♂, SAM, lectotype and paralectotype of *K. stensonsi*).

ACKNOWLEDGMENTS

I sincerely thank the persons who sent material for study. I express my gratitude to Friedrich W. Gess, Vincent F. Lee, Karl V. Krombein, David L. Wagner, and especially Arnold S. Menke for reviewing earlier versions of the manuscript; to Byron A. Alexander for his comments on the Phylogeny section; to Karl V. Krombein for in-



FIGURES 29–33. *Kohliella stevensoni*: 29—female clypeus, 30—male clypeus, 31—male mandible, 32—volsella, inner side, 33—penis valve.

formation on the habitat of *Kohliella anula*; to John Irish for information on Namibian localities; and to Friedrich W. Gess for donating specimens of *K. alaris*. Mary Ann Tenorio took the scanning electron micrographs and prepared the illustrations and the map of Africa, and George L. Venable generated the map of Sri Lanka.

LITERATURE CITED

- ARNOLD, G. 1922. The Sphegidae of South Africa, Part I. *Ann. Transvaal Mus.* 9:101–138.
- . 1924. The Sphegidae of South Africa. Part V. *Ann. Transvaal Mus.* 11:1–73, pl. I–II.
- BOHART, R. M. AND A. S. MENKE. 1976. Sphecids wasps of the world. A generic revision. University of California Press, Berkeley. 1 color plate, IX + 695 pp.
- BRAUNS, H. 1910. Neue Sphegiden aus Südafrika (Hym.). *Deutsche Entomol. Z.* 1910:666–670.
- DE BEAUMONT, J. 1967. Hymenoptera: Sphecidae. *South African Animal Life* 13:502–512.
- GESS, F. W. 1981. Some aspects of an ethological study of the aculeate wasps and the bees of a karroid area in the vicinity of Grahamstown, South Africa. *Ann. Cape Prov. Mus. (Nat. Hist.)* 14:1–80.
- GESS, F. W., AND S. K. GESS. 1980. Ethological notes on *Kohliella alaris* Brauns (Hymenoptera: Sphecidae: Larinae) in the eastern Cape Province of South Africa. *Ann. Cape Prov. Mus. (Nat. Hist.)* 13:45–54.
- MICHENER, C. D. AND A. FRASER. 1978. A comparative anatomical study of mandibular structures in bees. *Univ. Kansas Sci. Bull.* 51:463–482.
- PULAWSKI, W. J. 1971. *Les Tachysphex* (Hym., Sphecidae) de la région paléarctique occidentale et centrale. Państwowe Wydawnictwo Naukowe, Wrocław. 464 pp.
- . 1977. A synopsis of *Tachysphex* Kohl (Hym.,

<p>Sphecidae) of Australia and Oceania. Polskie Pismo Entomol. 47:203-332.</p> <p>———. 1979. A revision of the world <i>Prosopigastra</i> Costa (Hymenoptera, Sphecidae). Polskie Pismo Entomol. 49:3-134.</p>	<p>———. 1988. Revision of North American <i>Tachysphex</i> wasps including Central American and Caribbean species. Mem. Calif. Acad. Sci. 10:1-211.</p>
--	---